

LANDFILL GAS RECOVERY AT THE ASCON DISPOSAL SITE

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INTRODUCTION

The rapid rise in the cost of energy has prompted increased interest in the recovery and utilization of landfill gas (LFG) at locations throughout the United States. The U.S. Department of Energy (DOE) has estimated that the nation's solid waste landfills generate 200 billion cubic feet of methane gas annually. Except for a few locations, this potential resource is being lost to the atmosphere. Further, approximately 0.5 million tons of solid waste are added daily to active sanitary landfills in the United States.

The generation of methane gas during the anaerobic decomposition of landfilled solid waste is a well-known phenomenon. Landfill gas typically contains 50-60 percent methane. The balance is composed of carbon dioxide and trace quantities of many other gases. The rate of gas generation will generally be highest during the first few years after solid waste burial and will tend to decrease with time. The exact details of this time variation are not well known for full size landfills. Small scale experiments do not appear to simulate what is found in the field. For lack of a better understanding, it is often assumed that the long term gas generation rate, after the first few years, can be described by an exponential decay and associated half-life.

Theoretically, the maximum amount of methane which can be produced during the life of a gas-generating landfill is about 4.5 cu ft of methane per lb of refuse. This amount would not, however, be generated in a reasonable time. Moreover, actual recovery will be less than 100 percent. A maximum recovery of 1 to 2 cu ft of methane per lb. of refuse is considered reasonable at this time.

Initial efforts at LFG recovery occurred in Los Angeles County at the Palos Verdes Landfill operated by the Los Angeles County Sanitation Districts in the mid-1960s. From this modest beginning, LFG recovery technology has been successfully applied at five other landfills and is under active consideration at another 17 locations nationally.

ASCON SITE DESCRIPTION

The Ascon disposal site is located in the Wilmington area of Los Angeles, California. The site was a former borrow pit and occupies an area of approximately 38 acres. Household and commercial rubbish, tank bottoms from refining operations, and oil field drilling muds have been disposed at the site since 1960 to an average depth of about 60 feet. Soil is scarce at the site, and auto shredder waste is used as daily cover material for the compacted wastes.

A portion of the site was formerly used as a storage area for petroleum coke. Large quantities of water were added to these storage piles and resulted in perched water and high moisture conditions within the landfill. Filling operations are scheduled to cease in 1980.

FEASIBILITY STUDY

A field test program was conducted during 1976 at the Ascon site by SCS Engineers under contract to the site owner, Watson Energy Systems, Inc. This test program was designed to determine if methane gas could be technically and economically recovered from the site. Three test wells were installed and pumping tests performed over a 3-4 month period to determine:

- Gas composition as a function of withdrawal rates from the test wells.
- Gas flow rates as a function of pressure drop.
- Influence area of withdrawal wells.

During the field test program, preliminary negotiations were being conducted with an adjacent Shell Oil refinery for gas sales. Requirements for gas processing and delivery specifications were identified.

Results of the feasibility study indicated that up to 1170 cu ft per minute of LFG containing 500 to 550 Btu/cu ft could be recovered from the site. This withdrawal rate was estimated to be sustainable for at least 6 years. User requirements for the LFG were also found to be acceptable - compression to 70 psi and moisture removal at 40°F.

System design and installation proceeded and was completed in mid-1978. The LFG extraction system as originally installed was comprised of 24 vertical wells drilled to an average depth of 50 ft with associated header pipe collection system. PVC piping was used throughout the collection system. Wells were perforated for the lower 15 to 20 ft and sealed from the surface with concrete and bentonite clay.

The LFG compressor and cooling equipment utilized rebuilt equipment. A schematic of the gas withdrawal and processing system is shown in Figure 1.

During the placement of extraction wells, a number of unanticipated conditions were encountered. First, landfilled wastes were more compact and had a higher moisture content than indicated by the feasibility testing. Secondly, as a result of high moisture levels, wells would partially fill with water after drilling. Standing water levels were as high as 30 ft deep in some wells. This water could be pumped out, however replacement by seepage occurred with time. Injector pumps were installed in the deeper wells to remove excess moisture.

System start-up occurred in August 1978. Great variation existed in gas production rates of wells. Some wells were free-flowing and produced large quantities of LFG, while others were without positive pressure and yielded little or no gas, (even when considerable vacuum was applied). During the ensuing months, additional wells (averaging 35-40 ft deep) were installed to tap more productive areas of the site. Several none-producing wells were abandoned. A total of 60 wells are now located on the site.

The system has been operating essentially continuously since early 1979 and is currently capable of delivering up to 1050 scfm to the user. Deliveries are averaging about 800 scfm (1.2 mmcf/day). No

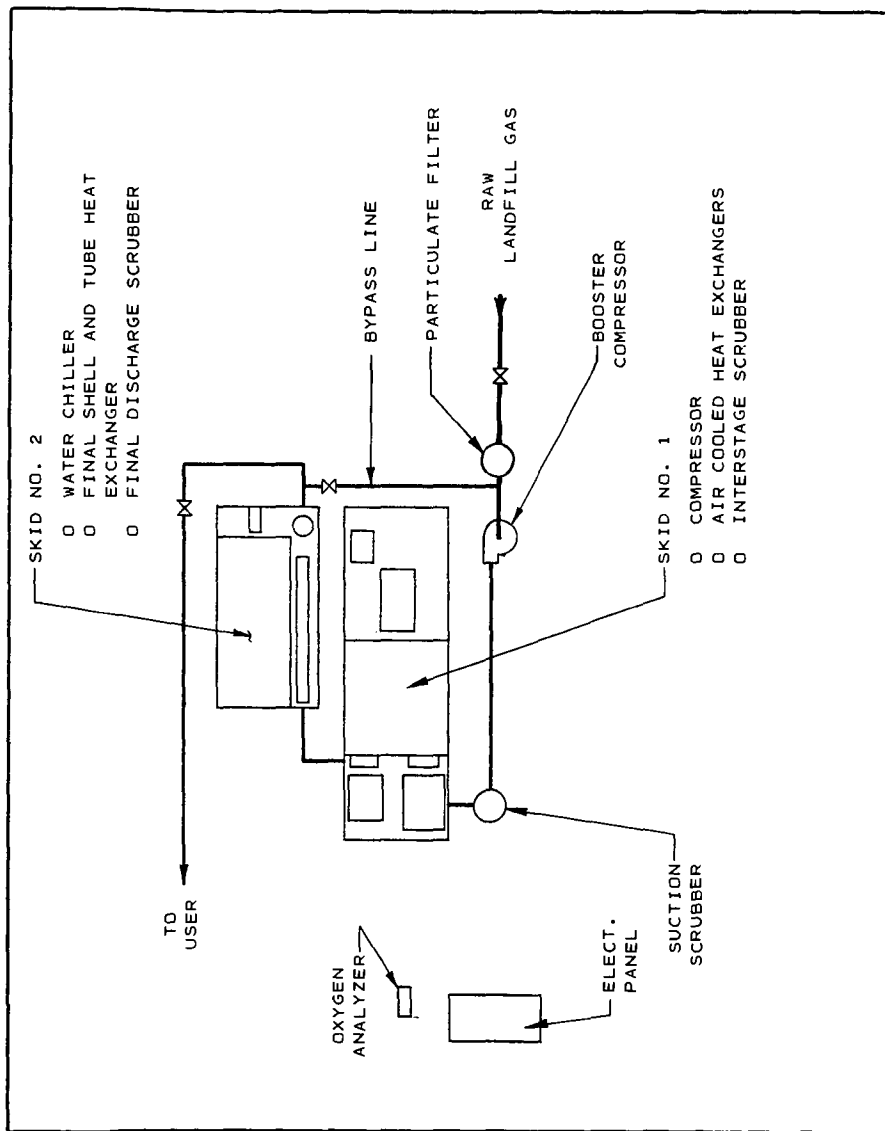


FIGURE 1. Schematic of Gas Withdrawal and Processing System

major operating difficulties or maintenance problems have arisen. However, supervision (8 hr/day) was found to be necessary for system adjustments. The system is also monitored by computer and equipped with an alarm system which shuts the system down if problems occur.

ECONOMICS

Tables 1 and 2 summarize the capital and operating costs associated with the installed system, respectively. Annual operating costs, including amortization of capital, average 45 percent of total installed cost.

Table 3 presents the estimated annual income from the system. As can be seen, a favorable economic return exists. The sales agreement between Watson Energy Systems, Inc., and Shell Oil pegs the value of the LFG to 70 percent of the value of #6 fuel oil on an equivalent Btu basis. Entitlements are earned by Watson Energy Systems, Inc., under the applicable DOE program.

GAS QUALITY

Gas quality at the Ascon landfill has been consistent with methane concentrations averaging in excess of 50 percent. Gas obtained from the Ascon landfill is routinely analyzed (bi-monthly) by an independent laboratory. A typical result is shown in Table 4.

Extensive analyses of gas obtained from one Los Angeles area landfill has identified more than 65 trace constituents in LFG. Trace components of the gas obtained from Ascon have been identified also. A sample analyses is contained in Table 5.

FUTURE FOR LFG RECOVERY

Increases in energy costs have given LFG recovery a needed "shot in the arm". An additional impetus is on its way from the U.S. Environmental Protection Agency (EPA). The Resource Conservation and Recovery Act (RCRA) requirements for controlling migration of LFG as dictated by EPA's sanitary landfill criteria require methane gas concentrations at the disposal site property line to not exceed 5 percent by volume. Methane gas concentrations in facility structures cannot exceed 1-1/2 percent by volume. These requirements will necessitate installation of LFG control systems at most sites. The installed LFG control system may include some of the same facilities (extraction wells, pumps, etc.) required for an LFG recovery system. If the LFG must be removed, many enterprising site owners will actively seek a profitable market for the gas.

Finally, DOE has become increasingly interested in LFG recovery. DOE is supporting a number of projects aimed at improving LFG recovery technology. A number of new projects are likely to be supported under provisions of P.L. 96-126. Legislation supporting LFG recovery has also been introduced at the Federal level.

Thus, we can expect more LFG recovery projects in future years. Hopefully, the beneficial effects associated with LFG recovery can dispell some of the negative public reaction to landfilling of our solid wastes, while contributing to our national fuel supply inventory.

TABLE 1.
SYSTEM CAPITAL COSTS (1978)

Compressor/Gas Chiller	\$103,000
Wells/Header	376,000
Discharge pipeline	35,000
Site work	10,000
Instrumentation/Controls	100,000
Electrical service	20,000
Engineering	65,000
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Total Capital	\$709,000

TABLE 2.
ESTIMATED ANNUAL OPERATING COSTS (1979)

Electrical Power (150,000 KW/mo. @ 5¢)	\$ 90,000
Compressor Maintenance (5% of capital cost)	5,200
Maintenance Labor (8 hr/day @ \$15)	43,800
Admin. & Testing (\$2500/mo)	30,000
Amortization (7 yr. @ 12%)	155,400
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Total Operating	\$324,400

TABLE 3.
ESTIMATED INCOME FROM GAS SALES (1979)

Direct Sales*:	\$517,000
Entitlements ⁺ :	137,000
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	\$654,000

*1.2 mmcf/day @ 535 Btu/cf @ \$2.45 mm Btu @ 90% availability.

⁺Estimated based on 65¢/mm Btu

TABLE 4.
MAJOR CONSTITUENTS - ASCON LANDFILL GAS

<u>Constituent</u>	<u>% (Volume)*</u>
Methane	55
Carbon Dioxide	42
Hydrogen	0.5
Oxygen	0.2
Nitrogen	1.2

*Average of several samples

TABLE 5.
TRACE CONSTITUENTS - ASCON LANDFILL GAS

<u>Constituent</u>	<u>Parts per Million*</u>
Acetone	32.5
Ethyl mercaptan	21.1
2-methyl furan	6.9
Methyl ethyl ketone	5.2
Benzene	5.5
Toluene	20.4
Terpene	12.4
Ethyl benzene	21.4
Xylene	14.9
Butyl alcohol	5.2
Alpha terpinene	11.1
Limonene	26.2
C ₃ substituted benzenes	9.8
C ₄ substituted benzenes	7.6
Dichlorobenzene	4.1
2-ethyl-1-hexanol	6.2
C ₄ - C ₁₄ hydrocarbons	114.2

*Sample date: May 15, 1979